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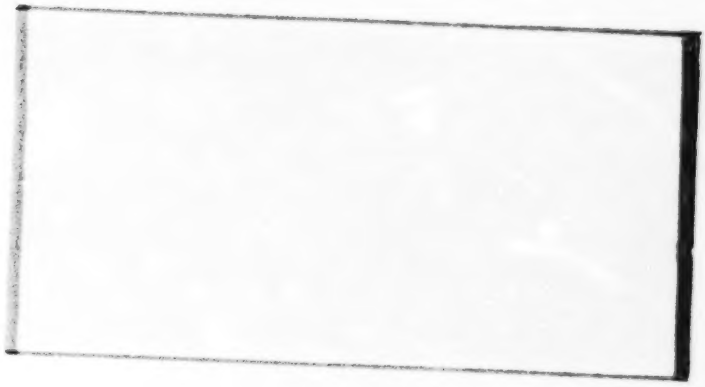

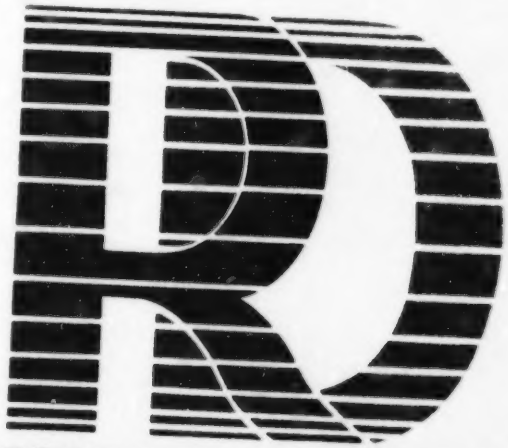

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PICKERING NGS 'B'
INTERIM AQUATIC STUDY, 1982

Report No 83-435-K

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ABSTRACT

This study is a survey of the ichthyofauna present in the vicinity of Pickering NGS 'B' during the 1982 commissioning year. Larval fish species collected in conical plankton nets set in the Pickering NGS 'A' intake forebay were alewife, smelt and yellow perch. Estimates of larval fish densities were within the range of those made during previous studies conducted at Pickering NGS 'B'. Alewife was by far the most abundant adult fish species collected during 1982. For most fish species, distribution patterns were such that no preference for the discharge locations was apparent. However alewife were particularly abundant near the Pickering NGS 'B' discharge in May, and white perch and white bass were caught in large numbers at the Pickering NGS 'A' discharge during the fall. Round whitefish aggregated off Thickson Point during the fall, and probably spawned near the 7 m contour, where four spent female fish were captured.

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To Dr. W.R. Effer
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PICKERING NGS 'B' INTERIM AQUATIC STUDY, 1982

1.0 INTRODUCTION

Preoperational aquatic studies at the Pickering 'B' Nuclear Generating Station (NGS) were concluded in 1981. In order to maintain a continuous record of the status of aquatic biota in the nearshore area adjacent to the station, the first year of a three-year interim aquatic study (1982-1984) was conducted at Pickering NGS 'B' at the request of Environmental Studies and Assessments Department of Design and Development Division.

Pickering NGS 'B' will have four CANDU powered 540 MW units when completed. The first reactor, unit 5, went critical on October 23, 1982. Units 6, 7 and 8 are scheduled to go critical in the fall of 1983, and the spring and fall of 1984, respectively. Pickering NGS 'B' shares a common surface intake with Pickering NGS 'A', but has a separate surface discharge directed to the east of the station.

During the 1982 to 1984 commissioning years for Pickering NGS 'B' units 5 to 8, aquatic sampling will be restricted to ichthyoplankton, and juvenile and adult fish in May, August, November and December of each year.

Testing of condenser cooling water pumps periodically between May and December 1982 resulted in very intermittent flows through the Pickering NGS 'B' discharge (maximum 15 m^3/s). There was no significant thermal discharge during 1982.

1.1 Objectives

The specific objectives of this study are:

1. Determine the distribution and abundance of adult and juvenile fish within the study area.

2. Determine the seasonal density and species composition of larval fish and eggs in the Pickering NGS 'A' forebay.

3. Continue the monitoring of fall-spawning round whitefish in the inshore area near Whitby as initiated in 1981.

1.2 Study Areas

The two study areas are shown in Figure 1. The main study area covers a 4.2 km stretch of shoreline from Pickering NGS 'A' discharge to Simcoe Point. Sampling points are located on two 2.5 km transects (M and O) set perpendicular to shore and spaced 0.5 km apart, and along two transects located at the Pickering NGS 'A' and 'B' discharges. The second study area encompasses two transects (P and Q) which run perpendicular to the shoreline off Whitby West and Thickson Point (Figure 1).

2.0 METHODS

2.1 Larval Fish

Larval fish were collected by suspending 0.5 m and 1.0 m conical nets in the Pickering NGS 'A' intake forebay. Two half-metre (0.5 m) diameter conical nets with a mesh size of 363 µm were employed weekly from May 1 to August 15, 1982 for two consecutive 10 min periods. These nets were suspended from the skimmer wall at approximately the 5 m depth. Paired one metre (1 m) diameter conical nets with a 1000 µm (1 mm) mesh size were suspended near the bottom of the intake forebay weekly from March 15 to May 25, 1982. Four consecutive 15 min sets of the larger conical plankton nets were made in an attempt to collect any fall-spawned fish larvae entrained in the intake current. All sampling was conducted at night between 2000 and 0300 h.

After each larval tow net was hauled to the surface at the end of a set, it was washed down with lakewater several times to ensure that no organisms remained attached to the net mesh. Each sample was immediately preserved in a 5% formalin solution upon retrieval. Densities of fish eggs and larvae were calculated as numbers/1000 m^3 of lakewater, using data obtained from flowmeters attached to the conical nets.

2.2 Juvenile and Adult Fish

Two sequences of juvenile and adult fish sampling were conducted. In the first sequence of regular sampling, fish were collected at Duffin Creek (transect M), Simcoe Point (transect O), and Pickering NGS 'A' and 'B' discharge locations in May, August and November (Figure 1). Triplicate beach seine hauls with a 15 m long (6.5 mm mesh size) beach seine were made near shore at

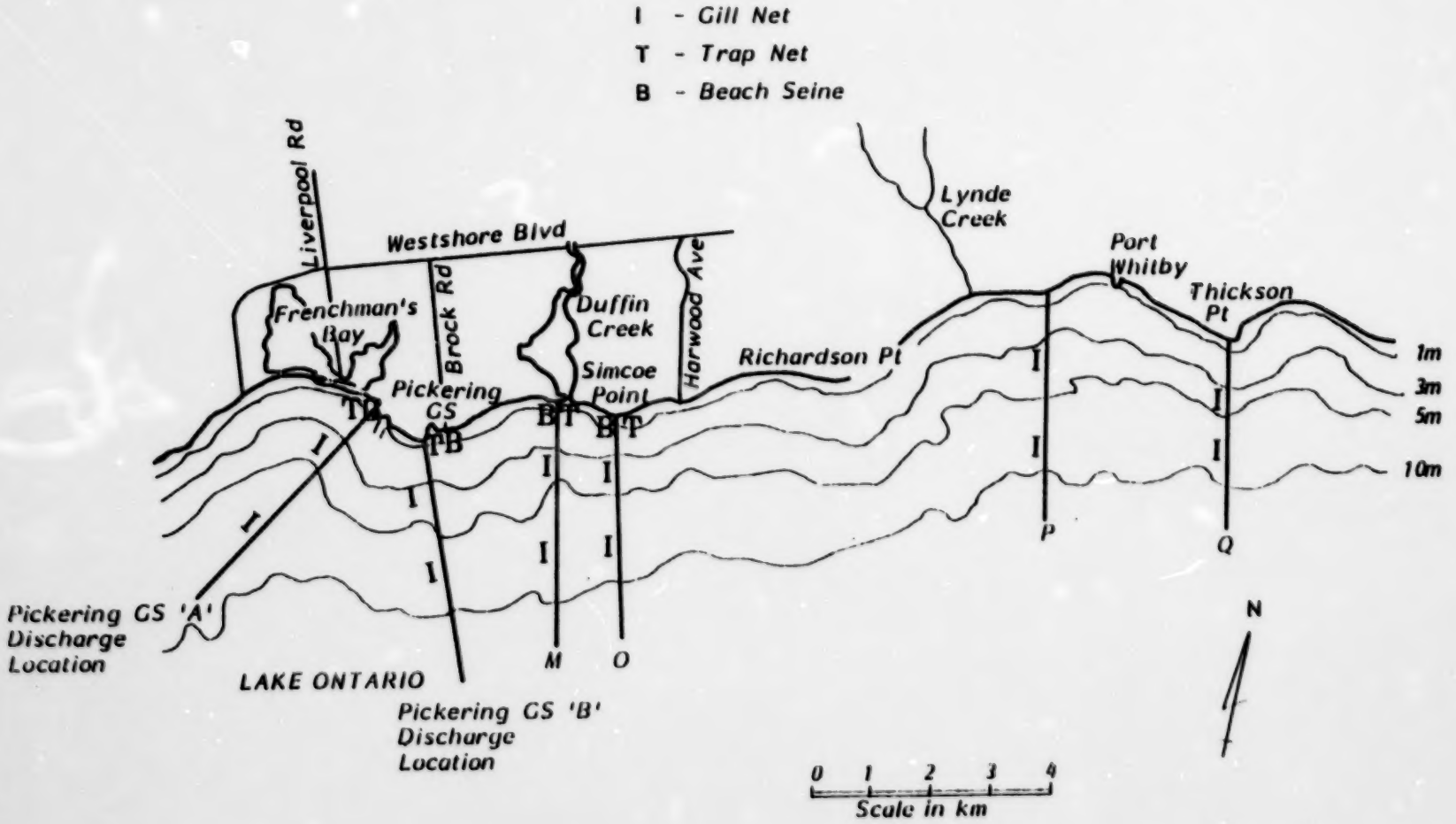

FIGURE 1

FISHING LOCATIONS
PICKERING GS 'B' INTERIM STUDY, 1982

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the four locations on June 7 and August 30, 1982. No beach seine hauls were made in November since previous studies demonstrated that few fish are collected by this method in the study area during the fall (Ontario Hydro Research Division Report Nos 82-266-K, 82-460-K and 83-193-K). Pairs of 1.2 m trap nets were set perpendicular to shore lakeward from the 3 m depth on two consecutive nights per month (May 19-21, August 24-25, and November 22-23, 1982) at each site. Inclement weather delayed the setting of trap nets at Simcoe Point and Duffin Creek until December 9, 1982. Two experimental gill nets, each consisting of eight panels with a mesh size range of 3.8 cm to 12.5 cm in 1.3 cm increments, were set along the bottom perpendicular to shore for two consecutive 24 h periods per month (May 18-19, August 17-19, and November 16-17, 1982) at each location. One gill net was set at the 3 to 5 m depth contour and the other at the 12 to 15 m contour (Figure 1). All fish collected were speciated and counted. Gill net and trap net catches were expressed as the catch per unit effort (ie, catch per single 24 h set), while beach seine catches were reported as catch per 3 hauls.

For the second sequence of fish sampling, experimental gill nets were set weekly (except for the week of December 13) from November 23 to December 21 along transects at Thickson Point and Whitby West. Gill nets were set perpendicular to shore at the 3 to 5 m and 7 to 10 m contours for 24 h, and had the same dimensions as the gill nets used in the first sampling sequence (see above). Ancillary observations included water temperature (°C) and Secchi depth (m).

Fork lengths (mm) and weights (g) were measured and scale samples collected from all salmonids and coregonids. Salmonid scales were sent to the Ministry of Natural Resources (MNR) for ageing in order to supplement their data on Lake Ontario salmonids. Coregonid scales were used in age and growth determinations.

3.0 RESULTS AND DISCUSSION

3.1 Larval Fish

Larval tows conducted from March through August in Pickering NGS 'A' intake forebay yielded 22 smelt (Osmerus mordax) larvae, 78 smelt eggs, 131 alewife (Alosa pseudoharengus) larvae, 645 alewife eggs, and 1 yellow perch (Perca flavescens) larva. The mean densities of eggs and larvae collected on each sampling date are presented in Table 1. Despite a total sampling volume of 16 934 m^3 of lakewater, no coregonid larvae were captured in the 1.0 m conical plankton nets deployed in the forebay during the March 15 to May 25 sam-

pling period. This result is not unexpected since coregonid larvae have rarely been captured in the nearshore area off Pickering GS (Ontario Hydro Research Division Report Nos 82-266-K, 82-539-K and 83-193-K). Densities of smelt eggs and larvae were estimated to be much lower in the large diameter (1.0 m), large mesh (1000 µm) plankton net than in the small diameter (0.5 m), small mesh (363 µm) plankton net (Table 1). Although this result may be due to vertical density differences in the forebay at the time of sampling, a more feasible explanation is that greater extrusion of smelt eggs and larvae occurred through the large mesh net than the small mesh net, since the diameter of a smelt egg and the width of a newly-hatched smelt larva are both less than 1.0 mm (the mesh size of the large net).

Peak densities of smelt eggs and larvae collected in 0.5 m nets on May 17 (180 larvae and 360 eggs/1000 m^3; Table 1) were similar to densities recorded in the forebay in 1979 and 1981, but maximum densities recorded in 1980 (8 695/1000 m^3 and 679/1000 m^3 for smelt eggs and larvae, respectively) were greater than those of the present study (Ontario Hydro Research Division Report Nos 82-266-K, 82-460-K and 83-193-K).

Alewife eggs were taken in 0.5 m nets on each sampling date from July 15 to August 16, with the peak density recorded on July 27 (7823/1000 m^3, Table 1). The density of alewife larvae was greatest on August 3, one week after the peak egg density. Alewife egg and larval densities did not differ substantially from densities previously recorded in the Pickering NGS 'A' forebay. The temporal occurrence of eggs and larvae of both smelt and alewife in forebay samples is consistent with known life history information (Scott and Crossman, 1973).

3.2 Juvenile and Adult Fish

The common and scientific names of all fish species captured at Pickering NGS 'B' in 1982 are listed in the Appendix.

3.2.1 Beach Seines

Beach seine catches contained fish species which commonly occur close inshore in the vicinity of Pickering NGS. Small-sized adult species included smelt, alewife and several different cyprinids, while juvenile fish captured included young-of-the-year smelt and yearling rainbow trout (Tables 2 and 3).

Table 1

Mean Densities (#/1000 m^3) of Fish Eggs and Larvae Collected by Conical Plankton Nets Suspended in Pickering NGS 'A' Forebay - Pickering NGS 'B' Study, 1982

	Large Diameter (1.0 m) Large Mesh (1000 µm) Net											
	March			April				May				
Species	15	22	29	5	13	19	27	4	11	17	25	
Smelt (larvae)	0	0	0	0	0	0	0	0	2	0	0	
Smelt (eggs)	0	0	0	0	0	0	0	0	2	16	2	

	Small Diameter (0.5 m) Small Mesh (363 µm) Net														
	May				June					July				August	
Species	4	11	17	25	1	8	14	21	28	5	15	20	27	3	16
Alewife (larvae)	0	0	0	0	0	0	0	0	0	0	0	0	0	1354	33
Alewife (eggs)	0	0	0	0	0	0	0	0	0	0	4230	1109	7823	1354	383
Smelt (larvae)	0	0	180	0	0	0	0	0	24	0	42	0	0	0	0
Smelt (eggs)	0	0	360	0	0	0	0	0	0	0	0	0	0	0	0
Yellow Perch (larvae)	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0

Smelt accounted for 57% of the overall beach seine catch, followed by alewife (18%), longnose dace (8%) and lake chub (5%). The remaining species comprised 3% or less of the total catch (Table 2). Smelt were more numerous in initial beach seine hauls (June 7) at all locations sampled except Duffin Creek, where the number of smelt collected was greater on the second sampling date (August 30) (Table 3). All smelt taken at Duffin Creek on August 30 were young-of-the-year fish which were possibly produced within Duffin Creek itself.

Table 2

Summary of Total Fish Catch in Regular Sampling
Conducted at Pickering NGS 'B' - 1982

Fish Species	Beach Seines		Trap Nets		Gill Nets		Total Catch	
	#	%	#	%	#	%	#	%
Alewife	49	17.63	4835	85.35	4190	68.32	9074	75.10
Rainbow Smelt	158	56.83	105	1.85	1126	18.36	1389	11.50
White Sucker	0	0.00	221	3.90	449	7.32	670	5.55
Brown Bullhead	0	0.00	359	6.34	1	0.02	360	2.98
White Bass	0	0.00	20	0.35	76	1.24	96	0.80
White Perch	1	0.36	48	0.85	42	0.68	91	0.75
Round Whitefish	0	0.00	0	0.00	69	1.03	69	0.57
Yellow Perch	3	1.08	39	0.69	11	0.18	53	0.44
Gizzard Shad	0	0.00	2	0.04	48	0.78	50	0.41
Brown Trout	0	0.00	0	0.00	35	0.57	35	0.29
Splake	0	0.00	0	0.00	27	0.44	27	0.22
Longnose Dace	21	7.55	0	0.00	0	0.00	21	0.17
Lake Trout	0	0.00	0	0.00	16	0.26	16	0.13
Lake Chub	15	5.40	0	0.00	0	0.00	15	0.12
Rainbow Trout	6	2.16	2	0.04	5	0.08	13	0.11
Coho Salmon	0	0.00	0	0.00	12	0.20	12	0.10
Rock Bass	0	0.00	10	0.18	2	0.03	12	0.10
Longnose Sucker	0	0.00	2	0.04	10	0.16	12	0.10
Carp	0	0.00	9	0.16	2	0.03	11	0.09
Spottail Shiner	9	3.24	0	0.00	0	0.00	9	0.08
Chinook Salmon	0	0.00	0	0.00	9	0.15	9	0.08
Logperch	6	2.16	0	0.00	0	0.00	6	0.05
Lake Whitefish	0	0.00	0	0.00	6	0.10	6	0.05
Slimy Sculpin	4	1.44	0	0.00	0	0.00	4	0.03
American Eel	0	0.00	3	0.05	0	0.00	3	0.03
Walleye	0	0.00	3	0.05	0	0.00	3	0.03
Freshwater Drum	0	0.00	1	0.02	2	0.03	3	0.03
Mottled Sculpin	3	1.08	0	0.00	0	0.00	3	0.03
Smallmouth Bass	0	0.00	2	0.04	0	0.00	2	0.02
Largemouth Bass	0	0.00	2	0.04	0	0.00	2	0.02
Emerald Shiner	2	0.72	0	0.00	0	0.00	2	0.02
Brook Trout	0	0.00	0	0.00	1	0.02	1	0.01
Redhorse Sucker	0	0.00	1	0.02	0	0.00	1	0.01
Channel Catfish	0	0.00	1	0.02	0	0.00	1	0.01
Johnny Darter	1	0.36	0	0.00	0	0.00	1	0.01
Total (# of species)	278	(13)	5665	(19)	6139	(21)	12,082	(35)

Table 3

Distribution of Fish Captured by Beach Seine (Catch per Three Hauls) on June 7 and August 30 in the Vicinity of Pickering NGS 'B' - 1982

Fish Species	Pickering NGS 'A' Discharge		Pickering NGS 'B' Discharge		Duffin Creek		Simcoe Point	
	Jun 7	Aug 30	Jun 7	Aug 30	Jun 7	Aug 30	Jun 7	Aug 30
Rainbow Smelt	2		46	2	3	10*	95	
Alewife	2		38		2		7	
Longnose Dace	1	1	1	2	2	10	3	1
Lake Chub		14						1
Spottail Shiner	1	1			5		2	
Logperch				3	2		1	
Rainbow Trout			1**	1**	4**			
Slimy Sculpin			3		1			
Mottled Sculpin			1		1		1	
Yellow Perch				3				
Emerald Shiner						2		
White Perch		1						
Johnny Darter							1	

* Young-of-the-year fish
** Yearlings

Alewife were taken in largest numbers at the Pickering NGS 'B' discharge location (Table 3). No alewife were captured on August 30, the time of year when both young-of-the-year and adult alewife would probably be migrating to deeper water (Scott and Crossman, 1973).

The distribution of other fish species caught in beach seine hauls was sporadic (Table 3). With the exception of 14 lake chub collected at Pickering NGS 'A' discharge on August 30, very few fish were taken on a single sampling date. Six (6) yearling rainbow trout were collected in beach seines at the Pickering NGS 'B' discharge and Duffin Creek sampling locations (Table 3). Several incidental beach seine catches of juvenile rainbow trout and round whitefish were made during the week of August 31 to September 3, 1982, near the beach area west of Pickering NGS 'A' discharge and east of Liverpool Road (see Figure 1). These fish were captured during fish collection for several laboratory studies. The total lengths of the four rainbow trout captured were 90, 160, 234 and 260 mm, while the three

round whitefish measured 160, 210 and 210 mm in total length. Although these fish were not aged, they probably were 1+ or 2+ fish, based on data provided in Scott and Crossman, 1973. Occurrence of these juvenile fish in close proximity to Pickering NGS 'A' discharge may be associated with feeding activities either in the discharge itself or elsewhere along the shoreline (eg, Frenchman's Bay). Continued beach seining efforts in inshore areas near Pickering GS during the summer may provide important information on the ecology of juvenile salmonids and coregonids.

3.2.2 Gill Nets and Trap Nets

A maximum of 21 fish species was present in gill and trap net catches totalling 6139 and 5665 fish, respectively (Table 2). Fish catch was generally lower than that recorded in previous surveys (1979, 1980 and 1981), especially for species such as alewife, white sucker, and brown bullhead (Ontario Hydro Research Division Report Nos 82-266-K, 82-460-K and 83-193-K). This result was most likely due to the fact that sampling was only conducted on three occasions (May, August and November/ December) during this study.

Alewife

Alewife was the most abundant species captured in both gill and trap nets. Catch per unit effort (CUE) of alewife in gill nets was highest at the 3 m contour of Pickering NGS 'B' discharge in May (294.5), followed by Duffin Creek (222.5), Pickering NGS 'A' discharge (112.0), and Simcoe Point (101.5) (Table 4). Gill net CUE values for alewife taken at the 12 m contour during May were less than those at the 3 m contour, ranging from 38.5 at Pickering NGS 'A' discharge to 85.0 at Pickering NGS 'B' discharge. These results suggest that some adult alewife are well inshore by mid-May and that of the four locations sampled in May, a slightly greater number of alewife may aggregate near the Pickering NGS 'B' discharge (at both 3 m and 12 m contours). During August the maximum gill net CUE occurred at the 3 m contour of Duffin Creek (298.0), and was more than double that observed at other locations (Table 4). A similar situation was noted for CUE values recorded at the 12 m contour except that the maximum CUE was at Simcoe Point (218.0). Although substantial differences existed in inshore (3 m contour) and offshore (12 m contour) CUE values during August, inshore catches were higher for Pickering NGS 'B' discharge and Duffin Creek locations, while offshore catches were greater at Pickering NGS 'A' discharge and Simcoe Point locations. November gill net catches of alewife were typically quite low at all locations sampled (Table 4). Alewife were captured in greatest abundance in trap nets set at Simcoe Point during May (CUE = 433.00) and Pickering NGS 'B' discharge during August (CUE = 90.50) (Table 5).

Table 4

Fish Catch per 24 h Gill Net Set at Four Locations
Sampled in May, August and November- Pickering NGS 'B', 1982

Fish Species	Pickering NGS 'A' Discharge						Pickering NGS 'B' Discharge						Duffin Creek						Simcoe Point					
	3 m Contour			12 m Contour			3 m Contour			12 m Contour			3 m Contour			12 m Contour			3 m Contour			12 m Contour		
	May	Aug	Nov	May	Aug	Nov	May	Aug	Nov	May	Aug	Nov	May	Aug	Nov	May	Aug	Nov	May	Aug	Nov	May	Aug	Nov
Alewife	112.0	27.5	0.0	38.5	95.0	0.0	294.5	126.0	0.5	85.0	101.0	0.5	222.5	298.0	8.5	74.0	97.0	2.5	101.5	110.0	3.0	78.0	218.0	0.5
Gizzard Shad	0.5	0.0	23.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coho Salmon	0.0	0.0	0.5	0.0	1.0	0.0	0.0	0.5	2.5	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.5	0.0	0.0	0.5	0.5	0.0	0.0	0.0
Chinook Salmon	0.0	0.0	0.0	0.0	0.5	0.5	0.0	0.5	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
Rainbow Trout	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0
Brown Trout	6.5	0.0	3.5	0.0	0.0	0.0	0.0	0.5	1.0	0.0	0.0	0.5	0.5	0.5	3.5	0.0	0.0	0.5	0.0	0.5	2.0	0.0	0.0	0.0
Brook Trout	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lake Trout	0.0	0.0	0.0	0.0	1.5	1.0	0.0	0.5	0.0	0.0	0.5	0.0	0.0	2.0	0.5	0.0	1.0	0.0	0.0	0.5	0.0	0.0	0.5	0.0
Splake	0.5	0.0	0.0	0.0	0.0	0.0	5.0	0.5	0.0	1.0	1.0	0.0	3.0	1.0	0.0	0.5	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
Lake Whitefish	0.5	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Round Whitefish	3.5	1.0	0.0	2.5	1.5	9.5	2.5	1.5	0.0	0.0	0.0	2.0	4.0	1.0	1.5	0.0	0.0	2.5	0.5	0.0	0.0	1.0	0.0	1.5
Rainbow Smelt	11.0	2.5	0.0	63.0	7.0	3.5	46.0	10.0	0.0	104.0	12.0	0.0	59.0	1.0	1.0	69.0	5.0	1.5	72.5	4.0	0.5	83.5	8.0	1.0
Longnose Sucker	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.0	0.5	0.0	0.0	2.0	0.0	0.0	1.0	0.0	0.0
White Sucker	13.5	5.5	2.5	2.0	2.0	5.0	34.5	53.0	1.0	5.0	6.0	1.0	33.5	24.0	4.5	1.0	7.0	1.5	5.0	6.0	5.0	9.5	0.0	3.5
Carp	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0
Brown Bullhead	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
White Perch	0.5	0.0	16.0	0.0	0.0	0.0	2.5	0.0	0.5	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
White Bass	8.5	12.5	11.0	0.0	0.0	0.0	1.0	0.0	2.0	0.0	0.0	0.0	1.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.0	0.0
Rock Bass	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0
Yellow Perch	0.5	0.0	0.5	1.0	0.0	0.0	0.5	2.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0
Freshwater Drum	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5

Fish Catch Per 24 h Trap Net Set at Four Locations
Sampled in May, August and November - Pickering NGS 'B', 1982

Fish Species	Pickering NGS 'A' Discharge			Pickering NGS 'B' Discharge			Duffin Creek			Simcoe Point		
	May	Aug	Nov	May	Aug	Nov	May	Aug	Nov	May	Aug	Nov
Alewife	21.50	33.50	0.00	294.50	90.50	0.00	397.00	14.75	--	433.00	19.75	--
Gizzard Shad	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	--	0.00	0.00	--
Rainbow Trout	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	0.50	--
Rainbow Smelt	0.00	0.00	0.00	2.75	0.75	0.00	13.25	4.75	--	3.25	1.50	--
White Sucker	0.25	5.00	0.00	0.00	21.50	0.50	12.00	4.00	--	5.25	6.75	--
Longnose Sucker	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	--	0.25	0.00	--
Redhorse Sucker	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	--	0.00	0.00	--
Carp	0.00	0.00	0.50	0.00	0.25	0.25	0.50	0.00	--	0.75	0.00	--
Brown Bullhead	1.00	9.00	0.00	0.50	23.75	0.00	30.50	3.00	--	18.00	4.00	--
Channel Cat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	0.25	0.00	--
American Eel	0.00	0.00	0.00	0.00	0.75	0.00	0.00	0.00	--	0.00	0.00	--
White Perch	0.50	0.00	5.00	0.00	0.00	0.25	3.25	0.00	--	3.50	0.00	--
White Bass	1.25	1.75	1.50	0.00	0.00	0.25	0.00	0.00	--	0.00	0.00	--
Rock Bass	0.25	0.00	0.00	0.00	0.00	0.00	0.50	0.25	--	1.50	0.00	--
Smallmouth Bass	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	0.50	0.00	--
Largemouth Bass	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	--	0.00	0.00	--
Yellow Perch	0.00	0.00	0.50	0.00	7.25	0.00	1.00	1.00	--	0.00	0.00	--
Walleye	0.25	0.00	0.25	0.00	0.00	0.00	0.00	0.00	--	0.25	0.00	--
Freshwater Drum	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	--	0.00	0.00	--

-- indicates no samples collected

Rainbow Smelt

Few rainbow smelt were collected in trap nets (Table 2), with the result that the maximum trap net CUE for this species occurred at Duffin Creek in May (13.25) (Table 5). The total gill net catch of smelt was 1126 fish (Table 2) and was relatively evenly spread across the four sampling locations during each sampling month (Table 4). The maximum gill net CUE of smelt was recorded at Pickering NGS 'B' discharge in May (104.0). A general trend observed for gill net catches of smelt is that offshore (12 m contour) CUE values were greater than inshore (3 m contour) values at all locations and in all months sampled (Table 4). This result may indicate that smelt move offshore shortly after spawning in the spring. Catch per unit effort values declined substantially from May to November, providing further evidence of movement of adult smelt to deeper waters after spawning.

White Sucker

A total of 670 white sucker were caught in 1982; 221 by trap net and 449 by gill net (Table 2). Highest CUE recorded in trap nets was 21.50, and occurred at Pickering NGS 'B' discharge in August (Table 5). Catches of white sucker in gill nets reflected the shallow-water distribution of this species, with inshore catches generally exceeding offshore catches at all locations and in all months sampled (Table 4).

Brown Bullhead

Brown bullhead were captured almost exclusively by trap net (Table 2). The CUE recorded in May at Duffin Creek was the highest (30.50), followed by Simcoe Point (18.00) (Table 5). Apart from a CUE of 23.75 at Pickering NGS 'B' in August, brown bullhead were not found in large numbers at the discharge locations.

White Perch and White Bass

During the 1982 sampling periods, the distributions of white perch and white bass were rather heterogeneous over the study area (Tables 4 and 5). These species were not very abundant at sampling times, accounting for less than 2% of the entire catch (Table 2). The gill net CUE for white perch was largest in November at Pickering NGS 'A' discharge (Table 4). A similar but less pronounced increase in gill net CUE of white bass was observed in August and November at Pickering NGS 'A' discharge (Table 4). Gill net values for both species remained low at other sites sampled. A slight increase in the abundance of white perch at Pickering NGS 'A' discharge in November was also

evident in trap net catches (Table 5). These data suggest that white perch and white bass may frequent the Pickering NGS 'A' discharge in the fall. Several previous studies have also identified an attraction of white perch and white bass to the Pickering NGS 'A' discharge during the fall period (Ontario Hydro Research Division Report Nos 79-218-K, 80-226-K, 82-266-K, 82-460-K, and 83-193-K).

Round Whitefish and Other Salmonids

Sixty-three round whitefish were captured in gill nets during fish sampling (Table 2). These fish were scattered over the study area and did not exhibit a clear preference for any specific location, although the highest catch occurred in November at the 12 m contour of the Pickering NGS 'A' discharge transect (CUE = 9.5) (Table 4). It is noteworthy that higher round whitefish catches consistently occurred at the 12 m contour than at the 3 m contour at all locations sampled. A single juvenile round whitefish was captured incidentally on September 14, 1982 in the 3.8 cm (1.5 inch) mesh of a gill net deployed in another study at the Pickering NGS 'A' intake. One juvenile rainbow trout was also captured at the same location on September 13. Both fish were 210 mm in total length. Few adult rainbow trout were taken in this study (Table 2). Other salmonids caught included 35 brown trout, 27 splake, 16 lake trout, 12 coho salmon, 9 chinook salmon and 1 brook trout. Six lake whitefish were also taken in 1982 (Table 2). No observable preference for discharge locations was exhibited by salmonids or coregonids.

All Species

With the exception of white perch and white bass most fish species did not show a preference for the Pickering GS 'A' discharge area over the three other sampling locations. This result suggests that the normal distribution of most fish species is not being altered by the presence of the thermal plume from Pickering GS 'A'. Further, intermittent flows from Pickering GS 'B' Unit 5 during 1982 did not appear to influence the shoreline distribution of fish in the Pickering region, since fish abundance in the Pickering GS 'B' discharge during 1982 was similar to that obtained in 1981 (Ontario Hydro Research Division Report No 83-193-K).

The Pickering GS 'B' discharge area appeared to differ from the Pickering GS 'A' discharge area in that white perch and white bass were most abundant at the latter location during the fall. The lack of thermal enrichment from Pickering GS 'B' during 1982 was likely the most important difference between the Pickering GS 'A' and 'B' discharge locations since both white perch and white bass are not normally associated with high current areas (Scott and Crossman, 1973).

3.3 Whitefish Survey

A total of 130 fish were captured during the fall-spawning fish survey conducted in November/December, 1982 (Table 6). Round whitefish accounted for 42% of the catch (55 fish), followed by white sucker (22%), brown trout (8%), alewife (6%), lake whitefish (5%), and white bass (5%). The remaining 12% of the catch included 3 lake trout, 2 rainbow trout and 1 chinook salmon.

Lake whitefish were only captured on November 23 at the 3 m contour off Thickson Point. The four lake whitefish which could be aged were 4+ and 5+ year-old males ranging in fork length from 470 to 520 mm and in weight from 1354 to 1668 g.

3.3.1 Distribution, Age and Growth of Round Whitefish

On each sampling occasion the total number of round whitefish caught off Thickson Point exceeded that at the Whitby West location, with the ratio of round whitefish captured increasing from 1.75:1 on November 23 to 14:1 on December 21 (Table 6).

This finding is consistent with the results of previous whitefish studies (Ontario Hydro Research Division Report Nos 82-460-K, 82-539-K and 83-193-K). With the exception of the fish catch at the Whitby West location on November 23, the catch per unit effort (CUE) of round whitefish at the 7 m contour (of either sampling location) exceeded that at the 3 m contour, regardless of the sampling date (Table 6), suggesting that these fish may prefer to remain offshore closer to the 7 m contour rather than inshore near the 3 m contour during the fall. Round whitefish were captured in largest numbers on December 8 (16 fish at the 7 m contour of Thickson Point), when the bottom water temperature had declined below 6.0°C. Catch per unit effort at Thickson Point was slightly lower by December 21, but water temperature dropped to 1.3°C in the same two-week period. This marked decline in water temperature was probably associated with substantial spawning activity since 4 spent female round whitefish were netted on December 21 (Table 7).

Rough weather prevented sampling during the week of December 13, but temperature records obtained by Hydraulic Studies and Development at about the 6 m contour off Thickson Point show a drop in temperature to near 2.0°C during that week.

Table 6

Summary of Catch Per 24 h Gill Net Set
During Pickering Fall-Spawning Fish Survey, 1982

	November 23				Total
	Thickson Point		Whitby West		
	3 m	7 m	3 m	7 m	
Alewife		5		2	7
Brown Trout	1		1		2
Lake Trout	1			1	2
Lake Whitefish	6				6
Round Whitefish	0	7	2	2	11
White Sucker	5		1	3	9
Total	13	12	4	8	37
	December 2				
Rainbow Trout	1				1
Brown Trout	1			1	2
Lake Trout	1				1
Round Whitefish		4		2	6
Northern Pike	1		1		2
White Sucker	2	2	2	1	7
Brown Bullhead			1		1
White Bass		1	1		2
Yellow Perch			1	1	2
Total	6	7	6	5	24
	December 8				
Alewife				1	1
Chinook Salmon	1				1
Rainbow Trout	1				1
Brown Trout	1		3		4
Round Whitefish	3	16	1	3	23
White Sucker	1		1	4	6
Carp				1	1
White Perch			1		1
White Bass			2	2	4
Total	7	16	8	11	42
	December 21				
Gizzard Shad			2		2
Brown Trout				3	3
Round Whitefish	2	12		1	15
White Sucker	3		2	1	6
White Bass		1			1
Total	5	13	4	5	27
Grand Total					130

Table 7

Distribution of Round Whitefish by Depth and Sex[1] During the Fall-Spawning Fish Survey - Pickering NGS 'B', 1982

Date	Mean Bottom Temperature (°C)	Thickson Point				Whitby West			
		3 m		7 m		3 m		7 m	
		M	F	M	F	M	F	M	F
Nov 23	6.0	0	0	1	3*	1*	0	1+1*	0
Dec 2	5.9	0	0	3*	1	0	0	2	0
Dec 8	5.7	3	0	7+2*	2+2*	0	0	0	3
Dec 21	1.3	2	0	7+1*	4**	0	0	1	0

* ripe fish M = male
** spent females F = female
[1] 47 of 55 fish were sexed

Female round whitefish were only caught along the 7 m contour, while males were taken at both the 3 m and 7 m contours (Table 7). Although female fish may have avoided capture by inshore (3 m) gill nets, it is more reasonable to conclude that female fish did not regularly frequent the inshore (3 m) area at the time of fall sampling. Thus absence of female fish close inshore may be a further indication that the main spawning event occurs farther offshore, at or near the 7 m contour. The sex ratio (male:female) was approximately 2:1, and was similar to that obtained in 1980, when one spent female round whitefish was netted (Ontario Hydro Research Division Report No 82-266-K).

A total of 83 round whitefish was aged, including 51 fish captured off Thickson Point and Whitby West (fall-spawning survey), and 32 fish taken as part of the regular Pickering NGS 'B' gill net sampling. All fish were collected between November 16 and December 21, 1982. The age composition of these fish is presented in Table 8.

Table 8

Age Composition of Round Whitefish Captured During November and December by Gill Nets - Pickering NGS 'B', 1982

	Age (Years +)							
	1+	2+	3+	4+	5+	6+	7+	Total
No of Fish Year Class	7 1981	1 1980	8 1979	28 1978	25 1977	12 1976	2 1975	83

Fish aged 4+ and 5+ dominated the entire fall catch of round whitefish. The 1977 year class has previously been demonstrated to be a comparatively strong one (Ontario Hydro Research Division Report No 82-539-K), but a large number of ripe fish belonging to the 1978 year class were captured in 1982, indicating that four-year old fish are a prominent age-group present during the spawning season. Two of the spent female fish captured were age 5+ and two were age 6+. No spent fish aged 4+ were obtained, despite their obvious abundance off Thickson Point in the fall. The 3+ age-group was also represented (4 in the Thickson Point area) although these fish were immature males. Fish in the youngest age-groups (1+ and 2+) were mainly caught in November at the 12 m depth offshore from the Pickering NGS 'A' discharge.

An important result is that all age-groups from 1+ to 7+ were represented in the 1982 fall catch (Table 8). This finding is good evidence that the round whitefish population in the vicinity of Pickering NGS is reproducing successfully.

Growth of round whitefish was examined by back-calculation of fork lengths at each scale annulus (Table 9). There was no evidence of Lee's phenomenon (the apparent progressive decrease in back-calculated lengths at a given age, as the age of fish from which measures were taken increases) among the fish caught in this study, suggesting that growth data was not biased by size-selective mortality or by sampling bias (Ricker, 1975). The progressive increase in mean back-calculated fork lengths at each age for a given year class is characteristic for fish in which the younger age-groups (1, 2 and 3) show rapid growth increments, while older age-groups exhibit slower growth (Table 9). A considerable amount of variation in growth was noted among the different year classes represented. For example mean growth increments ranged from 42.1 to 47.2 mm among fish aged 3 to 4 (Table 9). Such growth differences among fish cohorts are not unusual (Ricker, 1975). The average growth pattern for round whitefish collected in 1982 was similar to that observed for fish caught in the Pickering area during 1979, 1980 and 1981 (Ontario Hydro Research Division Report Nos 82-460-K and 82-539-K; Ontario Ministry of Natural Resources, 1980).

The mean back-calculated fork lengths of one-year-old fish were not very different from the 1975 year class through the 1979 year class, but increased substantially in the 1980 and 1981 year classes (Table 9). This difference in back-calculated fork length among year classes was reflected in the mean distance from the focus to the first annulus on fish scales. Thus exceptional growth of juvenile round whitefish can occur in some years. However too few juveniles (8) were taken to allow a comparison to be made between sampling locations. Additional

information on the residence of round whitefish in the discharge areas is required before any conclusions are drawn regarding possible differential growth rates among discharge and non-discharge fish.

Table 9

Mean Back-Calculated Fork Lengths (mm) at Each Scale Annulus for Round Whitefish Captured During November and December - Pickering NGS 'B', 1982

Scale Annulus#	Age at Capture (Sample Size)						
	7(2)	6(12)	5(25)	4(28)	3(8)	2(1)	1(7)
7	417.2						
6	400.5	411.4					
5	374.4	386.7	368.6				
4	343.2	352.6	341.7	343.9			
3	298.2	305.4	298.9	301.8	300.4		
2	240.2	245.2	220.0	232.9	227.1	222.0	
1	149.5	148.0	147.3	149.5	148.8	156.7	156.0

4.0 SUMMARY

Larval tows conducted from March through August in Pickering NGS 'A' intake forebay produced 154 fish larvae (including 22 smelt larvae, 131 alewife larvae and 1 yellow perch larva) and 723 fish eggs, of which 645 were alewife and 78 were smelt eggs. No coregonid eggs or larvae were collected. Peak densities of smelt and alewife eggs and larvae were in accordance with results of previous studies.

Thirty-five (35) fish species were represented in the total catch of 12 082 juvenile and adult fish captured in the near-shore area between Pickering NGS and Simcoe Point. The gill net, trap net and beach seine catches were respectively 6139, 5665 and 278 fish. Alewife dominated the total catch, and this species was taken in large numbers at all sampling locations. The majority of fish species captured in 1982 had distribution patterns which did not suggest an abnormal frequency of occurrence in discharge areas. However, white perch and white bass appeared to concentrate near the Pickering NGS 'A' discharge during the fall.

The fall-spawning fish survey resulted in the capture of 130 fish, including 55 round whitefish and 6 lake whitefish. Round whitefish were most abundant in gill nets set at the 7 m contour of Thickson Point, where four spent female round whitefish were taken on December 21 at a water temperature of 1.3°C. The male-to-female sex ratio of round whitefish was 2:1.

Round whitefish ranged in age from 1+ to 7+, with age-groups 4+ and 5+ containing largest numbers of fish. Spent female round whitefish were aged 5+ and 6+. The greatest number of juvenile (1+ and 2+) round whitefish occurred at the 12 m depth offshore from the Pickering NGS 'A' discharge during the fall. These fish had higher mean back-calculated fork lengths at age one than other fish captured, indicating that growth of juvenile round whitefish is quite variable and may be substantially higher for some year classes than for others.

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REFERENCES

Ontario Hydro Research Division Report No 79-218-K. 1979. Food and Condition of White Bass in the Pickering Discharge and Unheated Control Areas. H. Balesic.

Ontario Hydro Research Division Report No 80-226-K. 1980. Pickering NGS 'A' Three Year Post-Operational Summary Report, 1974-1976. J.K. Kwik and H. Balesic.

Ontario Hydro Research Division Report No 82-266-K. 1982. Pickering NGS 'B' Preoperational Biological Survey Year I, 1979. J.K. Kwik.

Ontario Hydro Research Division Report No 82-460-K. 1982. Pickering NGS 'B' Preoperational Biological Study - Year II. J.K. Kwik.

Ontario Hydro Research Division Report No 82-539-K. 1982. Pickering Round Whitefish Studies, Field Component, 1981-82. W.E. Carey.

Ontario Hydro Research Division Report No 83-193-K. 1983. Pickering NGS 'B' Preoperational Biological Study - Year III. J.K. Kwik.

Ontario Ministry of Natural Resources, 1980. Preliminary Report on a Whitefish Spawning Survey, Pickering, 1979. Lake Ontario Fisheries Assessment Unit Report 1980-2.

Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Fish. Res. Board Canada Bull. No. 191, 382 p.

Scott, W.B. and Crossman, E.J., 1973. Freshwater Fishes of Canada. Bulletin 184, Fisheries Res. Board of Canada, Ottawa, 966 p.

APPENDIX

COMMON AND SCIENTIFIC NAMES OF FISH SPECIES COLLECTED AT PICKERING NGS 'B' - 1982

Common Name	Scientific Name
Alewife	*Alosa pseudoharengus*
Brown Bullhead	*Ictalurus nebulosus*
Rainbow Smelt	*Osmerus mordax*
White Sucker	*Catostomus commersoni*
Emerald Shiner	*Notropis atherinoides*
Gizzard Shad	*Dorosoma cepedianum*
Yellow Perch	*Perca flavescens*
White Perch	*Morone americana*
Spottail Shiner	*Notropis hudsonius*
Carp	*Cyprinus carpio*
Round Whitefish	*Prosopium cylindraceum*
White Bass	*Morone chrysops*
Longnose Dace	*Rhinichthys cataractae*
Smallmouth Bass	*Micropterus dolomieui*
Walleye	*Stizostedion vitreum*
Splake	*Salvelinus namaycush* x *S. fontinalis*
Rock Bass	*Ambloplites rupestris*
Brown Trout	*Salmo trutta*
Logperch	*Percina caprodes*
Rainbow Trout	*Salmo gairdneri*
Slimy Sculpin	*Cottus cognatus*
Lake Chub	*Couesius plumbeus*
Longnose Sucker	*Catostomus catostomus*
Johnny Darter	*Etheostoma nigrum*
American Eel	*Anguilla rostrata*
Largemouth Bass	*Micropterus salmoides*
Coho Salmon	*Oncorhynchus kisutch*
Lake Trout	*Salvelinus namaycush*
Chinook Salmon	*Oncorhynchus tshawytscha*
Lake Whitefish	*Coregonus clupeaformis*
Freshwater Drum	*Aplodinotus grunniens*
Mottled Sculpin	*Cottus bairdi*
Brook Trout	*Salvelinus fontinalis*
Redhorse Sucker	*Moxostoma macrolepidotum*
Channel Catfish	*Ictalurus punctatus*
Northern Pike	*Esox lucius*